with a phrase indicating that the polymer has a "molecular weight distribution of less than 2." Support for this amendment is found throughout the specification as filed, for example, on page 42, lines 14-18; page 41, lines 21-26; Table 1 and Examples 3-22, as well as other locations throughout the specification. The novel polymers produced by atom transfer radical polymerization ("ATRP") grow in a controlled manner such that the molecular weight distribution is maintained in this narrow range.

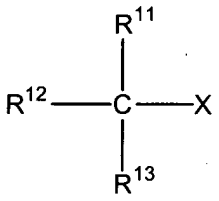
The term "predetermined" in claim 43 was replaced with a phrase including the parameters that may be used to predetermine the molecular weight. The molecular weight of the ATRP polymers grows linearly with conversion and therefore one may determine the molecular weight of a polymer from the amount and molecular weight of consumed monomer and the amount and molecular weight of the initiator. This amendment finds support in the specification as filed on page 46, lines 9-22; on page 78, line 25 to page 80, line 7; on page 83, lines 18-22; on page 85, lines 3 to 13 and shown graphically in Figures 5, 6, 10 and 11, as well as other locations throughout the specification as filed.

The phrase "a composition that changes in a predictable manner" in claims 35 and 36 has been deleted and substituted with a phrase "a composition that varies along the length of the(co)polymer" to clarify the meaning of the claim without narrowing its scope.

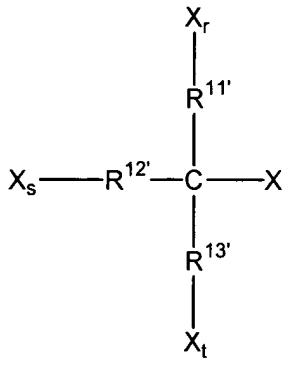
In paragraph 4(a) of the Office Action, claims 26, 38, 39, 64-67 are rejected under 35 U.S.C. §112, second paragraph, because in the Examiner's opinion the claims are indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. The Examiner indicates that the limitation in claim 64-66 reciting "with the provisio that R11', R12', and R13' have . . . polymer chains attached thereto" is not understood. Applicants have herein amended the claim to more clearly describe the

invention without narrowing the scope of the claims. The claims now include the limitation that the R groups may comprise a polymer chain. The parts of these claims including the above limitation describe novel polymer structures that may be formed by ATRP from an initiator with multiple initiation sites. Such initiators are described in the specification as filed on page 19, line 19 to page 20, line 26; more specifically, on page 20, lines 7 wherein one of R11, R12, and R13 may be "halogen"; and on lines 14-20 which describe additional R structures which include halogens; in ATRP halogens may be the radically transferable atoms creating sites for the addition of monomers and the formation of polymer chains. Examples of initiators comprising multiple radically transferable atoms or groups are listed on page 21, lines 6-18, as well as other locations in the specification as filed.

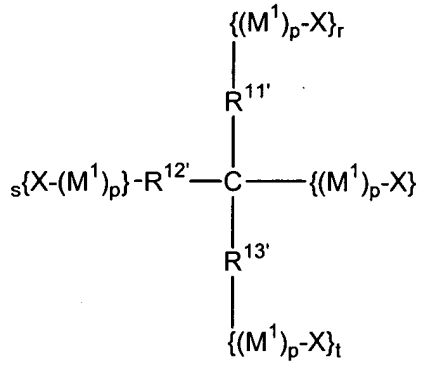
In ATRP, an initiator, typically, comprises at least one radically transferable atom or group, although, for example, an initiator for "reverse" ATRP may not comprise a radically transferable atom or group. Suitable initiators may be described by the following structure:



where X is the radically transferable atom or group. This structure is described in the specification beginning on page 19, line 19. As indicated above and described in the specification, the R groups may comprise additional "X" groups, which is taught in the specification as filed on page 38, line 7 to page 39, line 8, as well as throughout the specification. Therefore, an initiator of the above formula having additional radically transferable atoms or groups may be described by the following structure:



wherein, for example, $R^{11'}$-X_r merely describes an R^{11} configuration comprising r "X" groups in its structure. It should be noted that the specification as filed supports the interpretation of this structure wherein $R^{11'}$ does not comprise any atoms and the "X" group may be attached directly to the carbon atom. This property of suitable initiators is supported by the specification as filed on page 20, line 7 wherein any of the R groups themselves may be a halogen; on page 21, line 21 indicating carbon tetrachloride as a suitable initiator; on page 39, line 23 describing additional initiators that have two or more "X" groups attached to one carbon atom. After an atom transfer radical homopolymerization of M^1 utilizing such an initiator, the resulting polymer may be of the following formula:



wherein any of r, s, and t may be zero. This structure is described in the specification as filed and the present claims as follows:

$$(R^{11'}R^{12'}R^{13'}C)\text{-}\{(M^1)_p\text{-}X\}$$

wherein $\{(M^1)_p\text{-}X\}$ is a polymer chain, $R^{11'}$, $R^{12'}$ and $R^{13'}$ are the same as R^{11}, R^{12} and R^{13} as previously defined with the proviso that $R^{11'}$, $R^{12'}$ and $R^{13'}$ together comprise an additional 2 to 5 of the polymer chains.

Applicants believe that this structure is not indefinite as written in the claims in light of the specification as filed.

In paragraph 4(b), claims 64 and 65 have been rejected as indefinite since the limitation "copolymers of his topology comprising four or more comonomers" is considered by the Examiner to be inconsistent with other limitations in the claims. This phrase has been deleted from claim 64 and claim 65 has been deleted.

In paragraph 4(c), the Examiner rejected claims 64 and 67 as being indefinite due to the use of "..." and the subscripts. Applicants have amended the claims to more clearly indicate that the polymers of the claims may include any number of intervening groups by substituting the serially related subscripts with non-serially related subscripts. This amendment does not narrow the scope of the claims but merely clarifies the meaning of the original claim and the disclosure as filed.

In paragraph 4(d), the Examiner objects to the use of the number 100 without units. Applicants have amended the claim to include the units as a percentage. The subscripts in these claims are molar percentages of the monomer in each segment of the polymer and the total of the molar percentages of each segment are equal to 100%.

In paragraph 4(e), the Examiner objects to the phrase "substantially similar" as rendering claim 26 indefinite. Applicants herein amend claim 26 to overcome the object by merely defining the phrase substantially similar. This amendment does not narrow the scope of

the claimed invention.

In paragraph 4(f), claim 38 is rejected because in the Examiner's opinion the scope of the phrase "or group derived therefrom" cannot be determined. Applicant's herein amend the claim to include specific end groups.

In paragraph 4(g), claim 39 is rejected due to a typographical error in the claim indicating that the claim includes "square brackets". Applicants herein amend the claim to delete phrase including the word "square" and render the claim definite.

Claim Rejections under 35 U.S.C. §102

In paragraph 6, independent claims 21 and 28 and dependent claims 22, 23, 28, 31, 34, 55, 62, and 63 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 5,610,250 issued to Veregin ("Veregin"), specifically by Examples II, III, IV and VII. Veregin discloses a stable free radical polymerization process for the production of butyl acrylate homopolymers having a residue of a AIBN initiator on one polymer chain end and a thermally labile stable free radical, 2,4,6-tri-tert-butyl phenoxy, on the other chain end. In Examples II, III, IV and VII, these poly(n-butyl acrylate) resins are disclosed to be obtained with number average molecular weights of 2,486, 4,030, 16,736, 4,605, and 699.

Applicants herein amend claim 21 to specifically limit the end groups. These end groups are thermally stable, as opposed to thermally labile end groups of the polymers disclosed in Veregin. This limitation is described in Veregin in column 5, lines 1 to 7; column 9, lines 48 to 52; and again emphasized in column 17, lines 45 to 58. The nature of the thermally labile end group and the requirements of the bond strength are discussed in great detail in Veregin. In column 18, lines 6-62, where Veregin teaches that the stable free radical bond strength of 80 kcal/mole is too thermally stable to be useful in the polymerization process

disclosed in the application. Veregin describes an object of the invention disclosed in the patent to provide a "polymer product with a high monomer to polymer conversion and a narrow polydispersity, wherein said product is comprised of a covalently bound free radical initiator fragment at one end and a covalently bound stable free radical compound at the other end of the product, and wherein said stable free radical agent has improved thermal, acidic, and photochemical stability as a discrete molecular entity and as an end group bound to the polymer product." This is not the case with the end groups claims in claim 21 and therefore which limit all the claims which depend from claim 21. The end groups included in claim 21 and the claims dependent from 21 are thermally stabile. There is also no suggestion or motivation in Veregin or any other reference of record to modify the polymers of Veregin to include the end groups included in claim 21.

Claim 28 of the subject application claims a copolymer comprising units obtained from two or more free radically (co)polymerizable monomers, wherein the copolymer is a statistical, periodic or sequential copolymer and exhibits molecular weight distribution of less than 2.0 and known functionality on predominantly each of the polymer chain ends. The examples in Veregin do not provide for the formation of such a polymer. The examples only produce homopolymers of number average molecular weight of less than 20,000. In the previous Office Action, Applicants provided a technical article, Polymer Reprints 38(1) 454-455 April 1997, written by three of inventors listed in Veregin. The technical paper was published after the filing of Veregin. In the article, the authors indicate that the method disclosed in Veregin did not enable one skilled in the art to produce the polymers of claim 28. On line 13 of the first column of the article, the authors admit that "[i]nitially reactions with n-butyl acrylate provided oligomers that appeared to increase in molecular weight with time *and then stop*."

(emphasis added.) This is consistent with the examples of Veregin, wherein no high molecular weight polymers were formed. The article further indicates that prior to the disclosure in this article, the stable free radical polymerization process could not be used to polymerize acrylates and, specifically on page 454, column 1, line 18, the article states that "[c]hain extensions reactions with acrylate using TEMPO-terminated polystyrene macroinitiators, which had been repeatedly been used for chain extensions with styrene, *also proved unsuccessful.*" (emphasis added.) The summary of the article states that the problem has been resolved in the article dated April 1997 and that a better understanding of the mechanism of the acrylate polymerization allowed reaction conditions to be chosen that "*enabled* the reaction to proceed successfully." Therefore, according to the authors the reaction was not previously enabled, and this explains the absence of examples of the copolymers in Veregin. The effective date of the subject application is prior to the disclosure of this article and is not prior art, therefore, Applicant contend that claim 28 should be allowable as they were the first to produce these unique polymers.

Claim Rejections under 35 U.S.C. §102

Claims 24, 25, and 32 stand rejected under 35 U.S.C. §103 because the Examiner maintains his belief that these claims are unpatentable over ("Veregin"). The Examiner in the Office Action found the argument provided by the Applicants unconvincing since the "[n]owhere in the cited article is the Veregin patent mentioned, nor does the cited subject matter of the article correspond with the passage in the patent cited against the instant claims." Applicants herein amend claim 24 to include specific end groups that are not anticipated or rendered obvious by Veregin. There is no motivation or suggestion in Veregin to produce the polymers of claim 24 and the claims dependent therefrom, claims 25 and 32 and

therefore the claims as amended herein are neither anticipated or obvious based on the Veregin.

Allowable subject Matter

The Examiner has indicated that the claims 29, 30, 33, 44, and 56-59 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all the limitations of the base and any intervening claims. Applicants have rewritten claims 33, 56, and 58 in independent form including all the limitations of the base claim and any intervening claim, these claims correspond to new claims 80, 76, 78. However, Applicants indicate that claims 29, 30, and 40 are already in independent form. Claims 77 and 79 are claims 57 and 59 rewritten to depend from new independent claims 76 and 78 which are in allowable independent form.

New Claims

New independent claim 68 is added herein based on claim 21 with the added limitation that the polymer comprises an average molecular weight in excess of 20,000 g/mol. This limitation distinguishes the polymer from the polymers described in Veregin. The disclosure of Veregin does not produce polymers with a molecular weight in excess of 20,000 g/mol as evidenced by the Examples in Veregin and the technical article cited above wherein the authors state that the "reactions with n-butyl acrylate provided oligomers that appeared to increase in molecular weight with time *and then stop*." The reaction described in Veregin cold not produce polymers in this molecular weight range. Claims 69-75 depend from new claim 68.

CONCLUSION

In view of the foregoing amendments, Applicants respectfully submit that the subject

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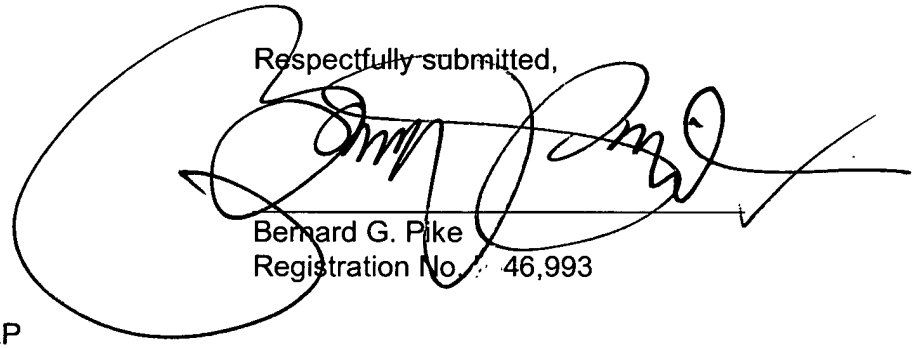
application is in condition for further examination and allowance. Such action at an early date is respectfully requested. Should the Examiner have any remaining concerns regarding the application's claims, he is requested to contact the undersigned at the telephone number below so that those concerns may be addressed in an interview with the Examiner. In addition, should the Examiner deem that there remain grounds outstanding for objecting to the Subject Application, as amended herein, Applicants respectfully request that any subsequent action objecting to the Subject Application not be made final.

Respectfully submitted,



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